

# Performance of Mixed Layer Models in the Mediterranean Sea

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Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE <b>2008</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2008 to 00-00-2008</b>	
4. TITLE AND SUBTITLE <b>Performance of Mixed Layer Models in the Mediterranean Sea</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Naval Research Laboratory,Stennis Space Center,MS,39529</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>Ocean Sciences 2008</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>11</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

## The vertical mixing models in HYCOM

- KPP** → Large et al. (1994)
- GISS** → Canuto et al. (2002)
- MY2.5** → Mellor and Yamada (1982)
- KT** → Kraus and Turner (1967)
- PWP** → Price et al. (1986)

*We would like to answer the question:*

How do these different mixed layer models perform under a given atmospheric forcing?

# Ocean Model

- **HYbrid Coordinate Ocean Model (HYCOM)**
- **Ocean basin:** Mediterranean Sea
  - 20–layers
  - 3 m top layer thickness
- **Model resolution:**  $1/25^\circ \cos(lat) \times 1/25^\circ$ 
  - average grid resolution is  $\approx 3.5$  km.
- **Heat fluxes:**
  - Shortwave radiation attenuation: turbidity
  - Blackbody longwave radiation correction
  - Bulk formulae for latent and sensible heat based on model SST



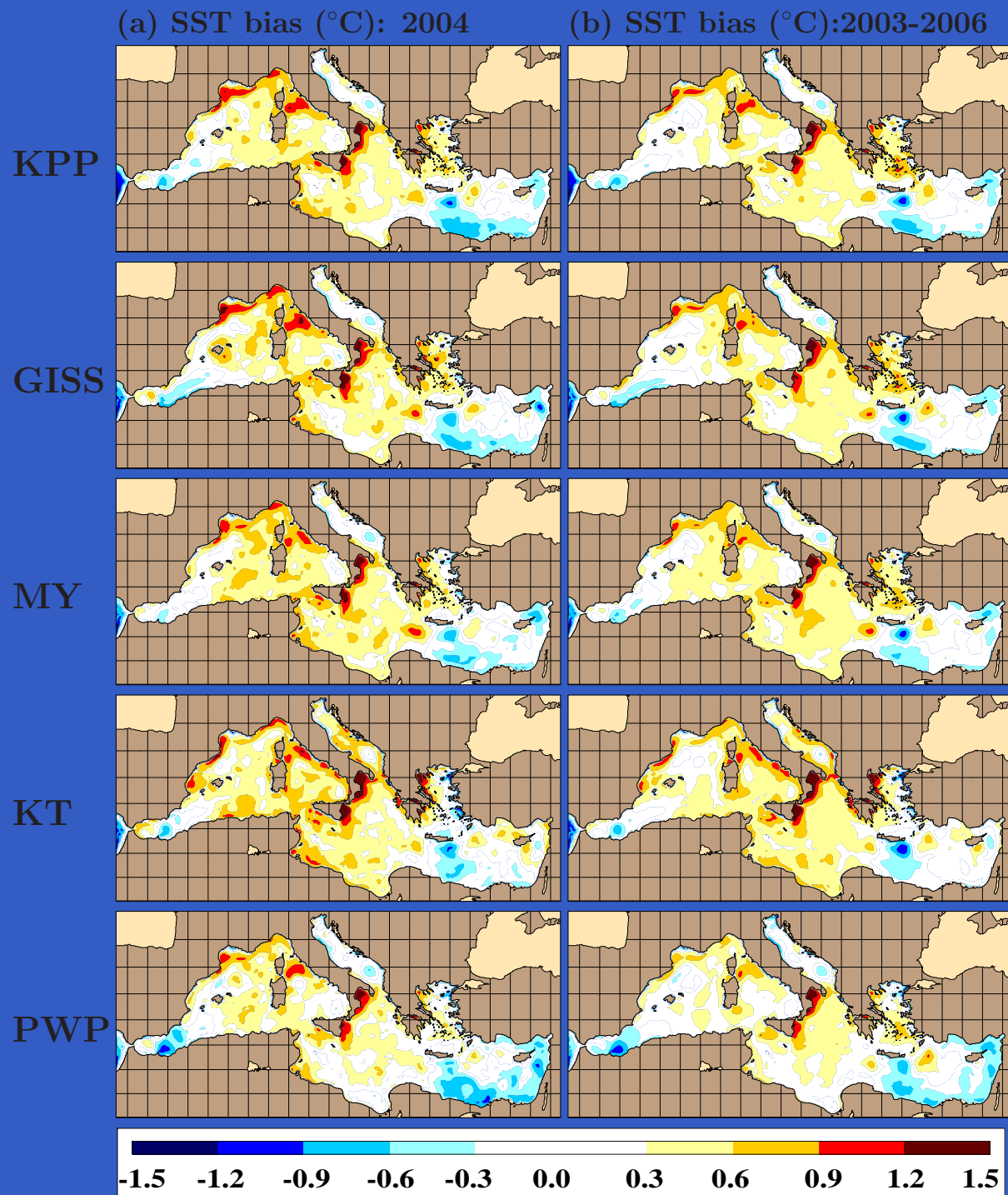
# Mediterranean Sea HYCOM simulations

<b>Simulation period</b>	2003 through 2006
<b>Atmospheric forcing</b>	3 hourly NOGAPS
<b>T and S initialization</b>	GDEM3 climatology
<b>Data assimilation</b>	None
<b>Relaxation to SST</b>	None
<b>Relaxation to salinity</b>	sea surface salinity

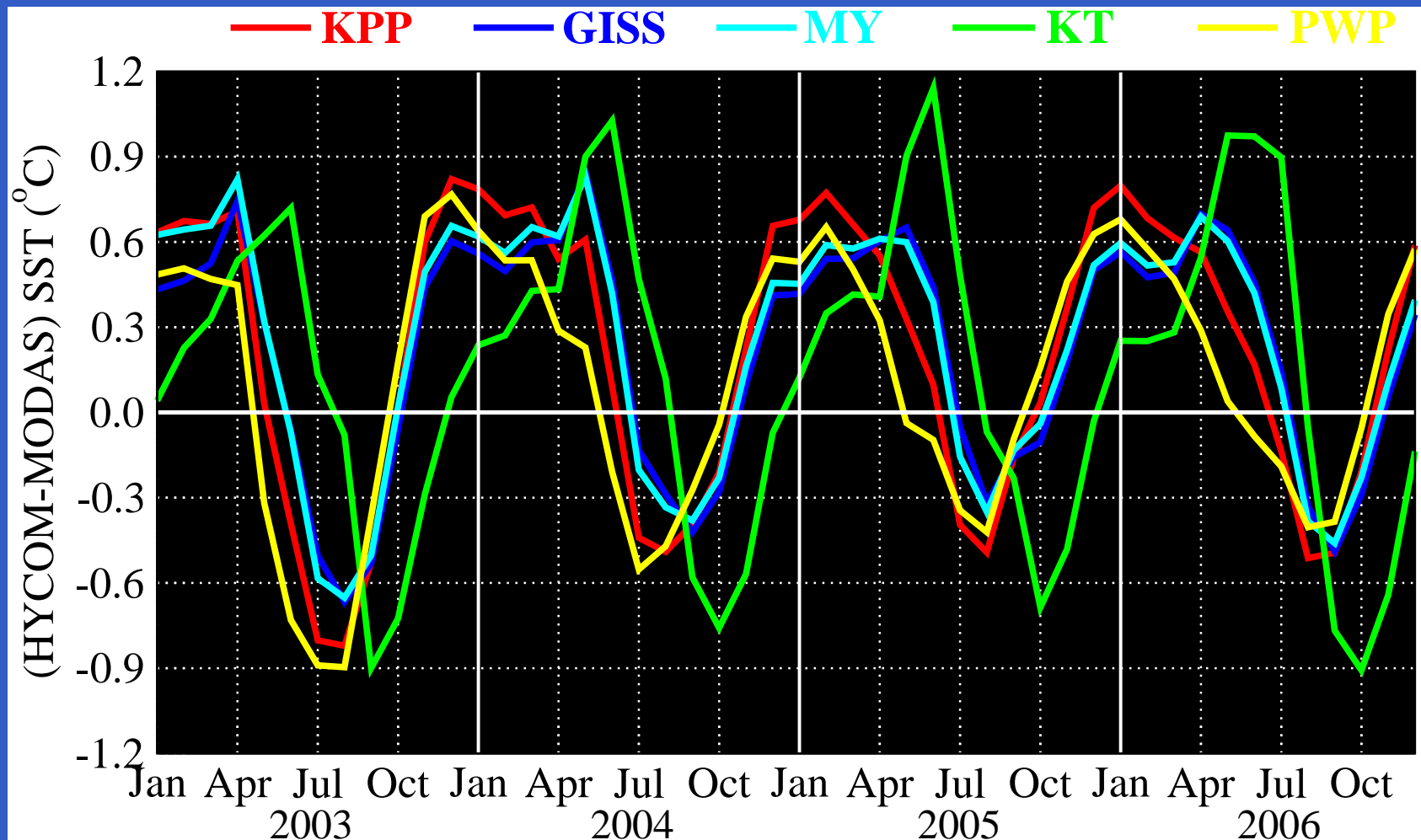
NOGAPS: Navy Operational Global Atmospheric  
Prediction System

GDEM: Generalized Digital Environmental Model (v3)

# Mean SST Bias from Mixed Layer Models

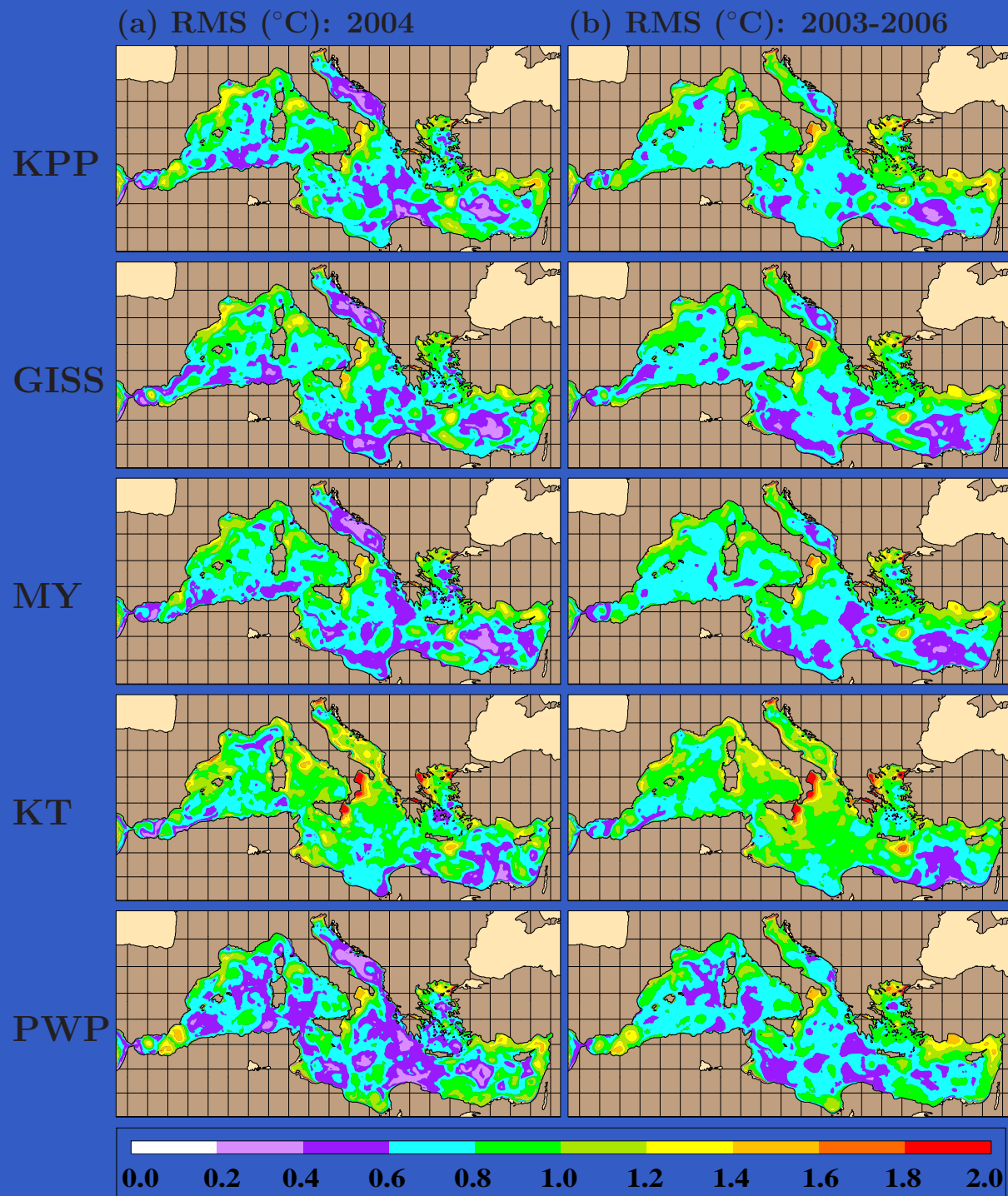


## Basin-Averaged Monthly Mean SST Bias: 2003–2006



Annual mean bias is  $\approx 0.1^{\circ}\text{C}$  from all models.

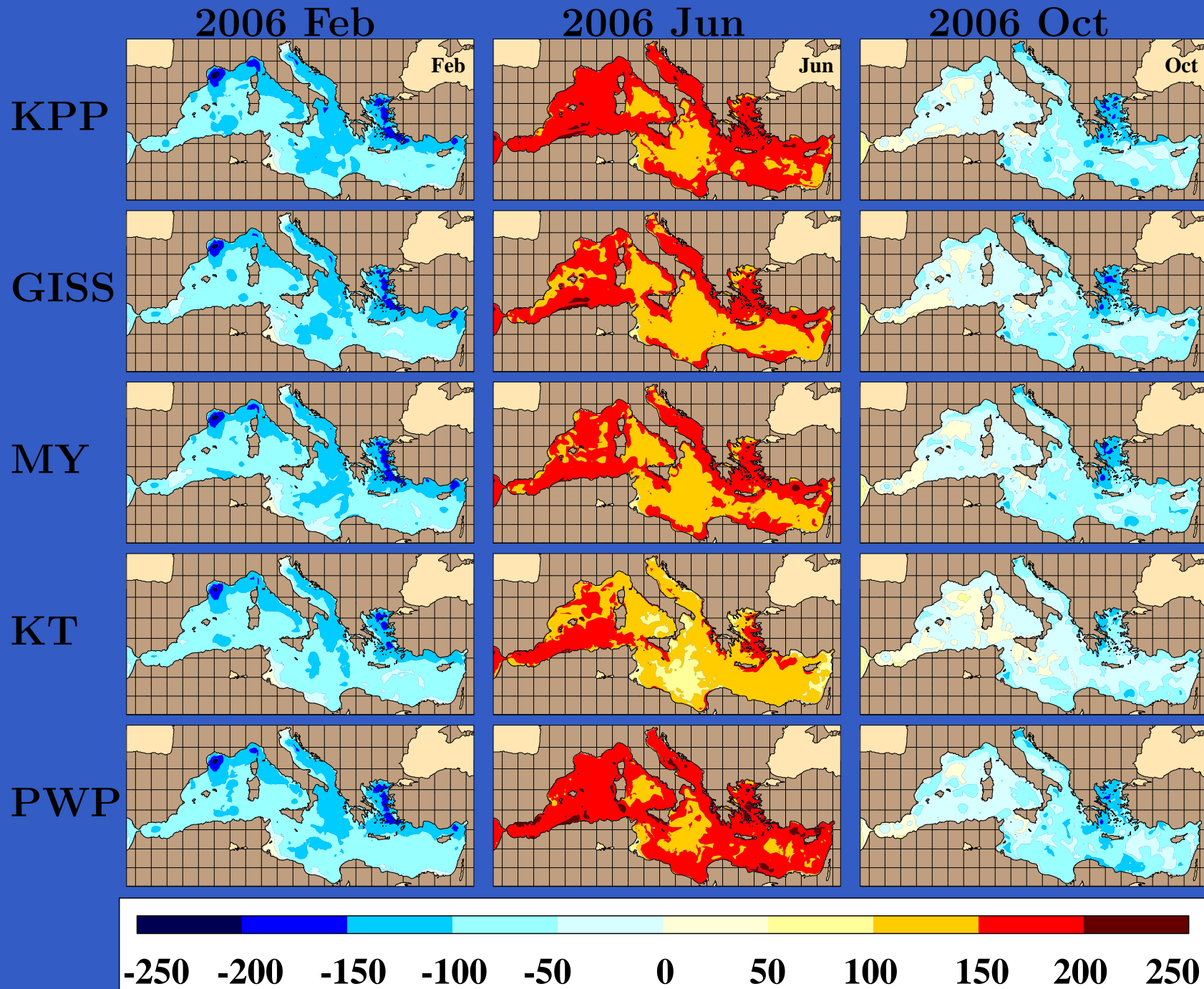
# RMS SST Difference from Mixed Layer Models



# Basin–Averaged RMS SST Difference (°C) by Year

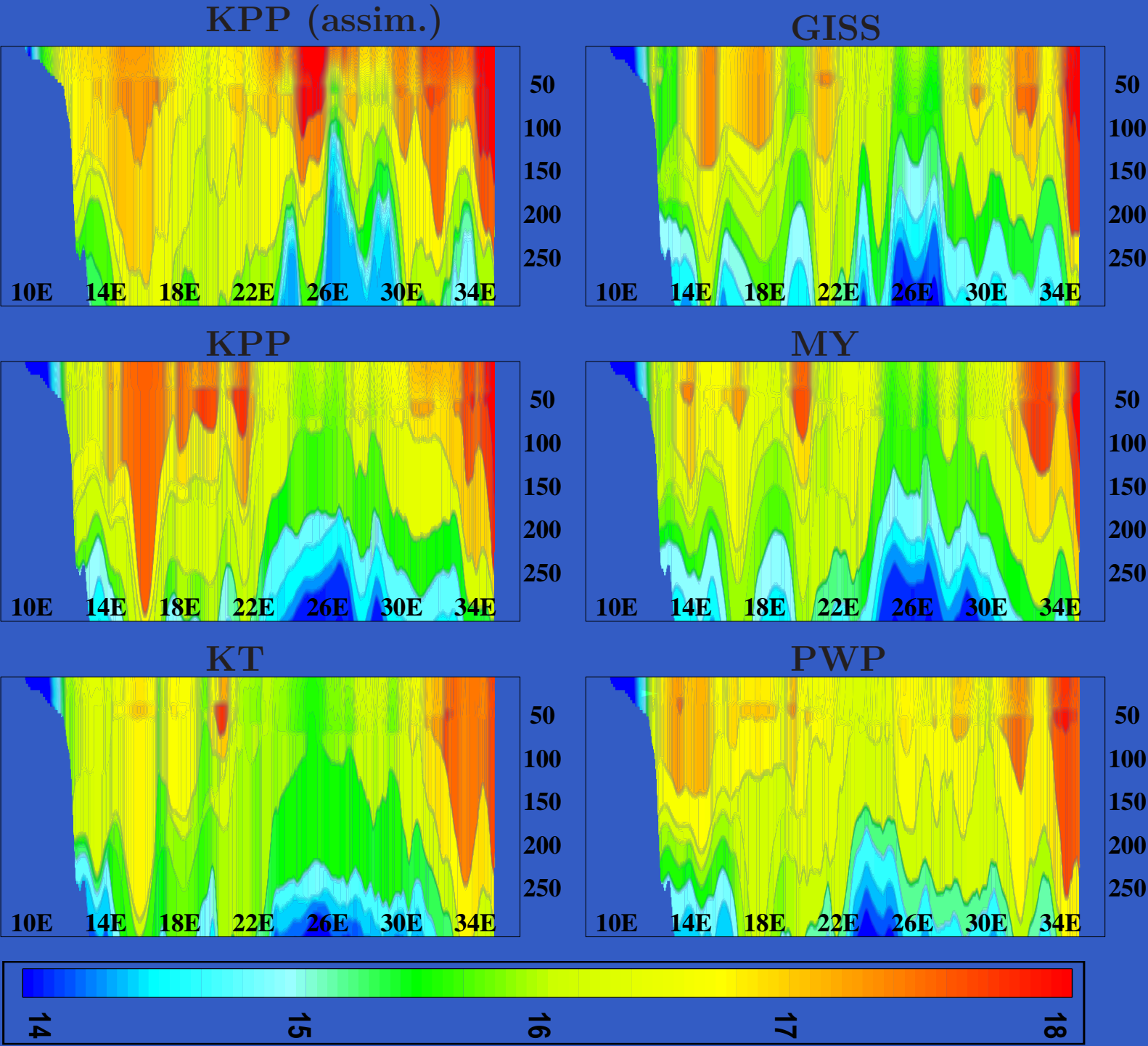
	2003	2004	2005	2006	2003-2006
KPP	0.86	0.78	0.79	0.78	0.81
GISS	0.79	0.76	0.76	0.76	0.78
MY	0.83	0.75	0.74	0.75	0.78
KT	0.88	0.88	0.90	0.96	0.91
PWP	0.90	0.73	0.74	0.73	0.79

# Net surface heat flux ( $\text{W m}^{-2}$ )





# Subsurface temperatures (°C): February 2006



# Summary and Conclusions

- All mixed layer models perform similarly:
  - validation against MODAS SST
  - 0.8°C RMS difference
- Upwelling from each model varies.
- Changes in the net surface heat flux
  - 50 W m<sup>-2</sup> difference from KT
- Future work:
  - mixed layer depth analysis
  - comparisons to ARGO, WOA profiles